UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,976,052 B2
APPLICATION NO. : 09/761264
DATED : December 13, 2005
INVENTOR(S) : Michael E. Tompkins et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page, drawing should be deleted to appear as per the attached Fig. 1.

The sheets of drawings consisting of figures 1-13 should be deleted as per attached figures 1-13.

Page 3, OTHER PUBLICATIONS,
delete "Photgraph of an ACC SC-200 circuit board." and insert --Photograph of an ACC SC-200 circuit board.--;
delete "Siege's Supplemental memorandum of law on the Construction of Claims 1 and 37" and insert --Siege's Supplemental Memorandum of Law on the Construction of Claims 1 and 37--.

Column 1,
Line 62, delete "away from the sap" and insert --away from the spa--.

Column 2,
Line 12, delete "start" and insert --start--.

Column 5,
Line 1, delete "the signals" and insert --the low signals--.
Line 14, delete "**6f**" and insert --of--.

Column 6,
Line 67, after "base" delete "be".

Column 7,
Line 40, delete "**4Q**" and insert --**40**--.

Column 8,
Line 28, delete "fo" and insert --of--.
Line 43, delete "the turn" and insert --then turn--.
Line 52, delete "TEMPERTURE" and insert --TEMPERATURE--.

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Column 9,
Line 3, delete "(pH input" and insert --(pH input)--.
Line 35, delete "CALn." and insert --CALn--.
Line 55, delete "setting" and insert --setting.--.
Line 66, delete "Ln:xx" and insert --Hn:xx--.

Column 10,
Line 18, delete "th" and insert --the--.
Line 21, delete "use" and insert --user--.
Line 34, delete "Hn:Er" and insert --PH:Er--.
Line 37, delete "he" and insert --the--.
Line 41, delete "marches" and insert --matches--.
Line 53, delete "if a" and insert --if the--.

Column 11,
Line 47, delete "is maintenance mode" and insert --is in maintenance mode--.
Line 53, delete "re" and insert --are--.

Column 12,
Line 9, delete "fog" and insert --from--.
Line 42, delete "a on/off" and insert --an on/off--.
Line 43, delete "hey" and insert --they--.

Column 13,
Line 18, delete "or" and insert --for--.
Line 22, delete "dressed" and insert --pressed--.

Column 16,
Line 4, delete "Present" and insert --present--.

Column 17,
Line 12, delete "trough" and insert --through--.
Line 13, delete "lag" and insert --flag--.
Line 43, delete "Th&up" and insert --The up--.

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Column 19,
Line 19, delete ",are" and insert --the--.
Line 41, delete "or" and insert --for--.
Line 52, delete "here" and insert --there--.
Line 55, delete "heaving" and insert --heating--.
Line 64, delete "ox" and insert --of--.

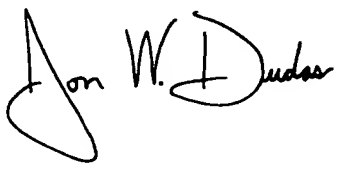
Column 20,
Line 2, delete "scheduler" and insert --scheduled--.
Line 7, delete "educe" and insert --reduce--.
Line 38, delete "sa" and insert --spa--.
Line 38, after "unattended" insert --.-- (a period).

Column 21,
Line 26, delete "convening" and insert --converting--.

Column 22,
Line 7, delete "Interconnection" and insert --interconnection--.

Signed and Sealed this

Fifteenth Day of January, 2008



JON W. DUDAS
Director of the United States Patent and Trademark Office

(12) **United States Patent**
Tompkins et al.

(10) **Patent No.: US 6,976,052 B2**
(45) **Date of Patent: Dec. 13, 2005**

(54) **SPA CONTROL SYSTEM**

(75) Inventors: **Michael E. Tompkins**, Houston, TX (US); **Michael J. Green**, Houston, TX (US)

(73) Assignee: **Balboa Instruments, Inc.**, Tustin, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 373 days.

(21) Appl. No.: **09/761,264**

(22) Filed: **Jan. 16, 2001**

(65) **Prior Publication Data**

US 2001/0029407 A1 Oct. 11, 2001

Related U.S. Application Data

(63) Continuation of application No. 08/822,179, filed on Mar. 20, 1997, now Pat. No. 6,253,227, which is a continuation of application No. 08/703,177, filed on Aug. 23, 1996, now abandoned, which is a continuation of application No. 08/327,927, filed on Oct. 24, 1994, now Pat. No. 5,559,720, which is a continuation of application No. 08/225,282, filed on Jan. 11, 1994, now Pat. No. 5,361,215, which is a continuation of application No. 07/224,869, filed on Jul. 26, 1988, now abandoned, which is a continuation-in-part of application No. 07/054,581, filed on May 27, 1987, now abandoned.

(51) **Int. Cl.**[7] **G06F 13/00**
(52) **U.S. Cl.** **709/201**; 4/493; 210/169
(58) **Field of Search** 210/169; 709/201; 392/465, 466, 485, 498; 219/497, 481, 489; 4/538, 539, 540, 541.1, 541.2, 541.3, 493

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(Continued)

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(Continued)

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Newspaper article: Mary Kay Seff, "Bathrooms are getting pretty splashy," San Diego Union Tribune, May 9, 1986.

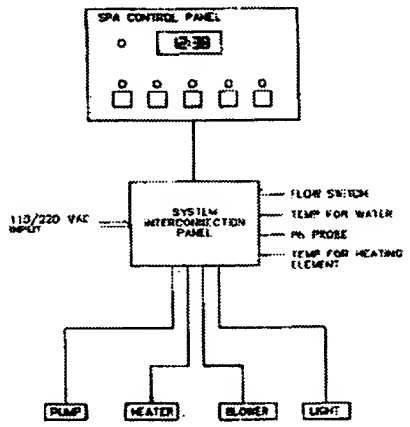
(Continued)

Primary Examiner—Moustafa M. Meky
(74) *Attorney, Agent, or Firm*—Pulwider Patton Lee & Utecht LLP

(57) **ABSTRACT**

An improved spa control system is disclosed. The invention describes a spa control system which calculates the time required to heat the water in the spa system to a desired temperature. From that information, the heating rate of the spa system can be determined, and the heating element of the spa system can be activated at the proper time to raise the temperature of the water to a selected temperature by a desired time. The spa system also monitors information which might show errors in the operation of the spa system such as a blockage in the flow of water over the heating element in the spa system.

24 Claims, 8 Drawing Sheets



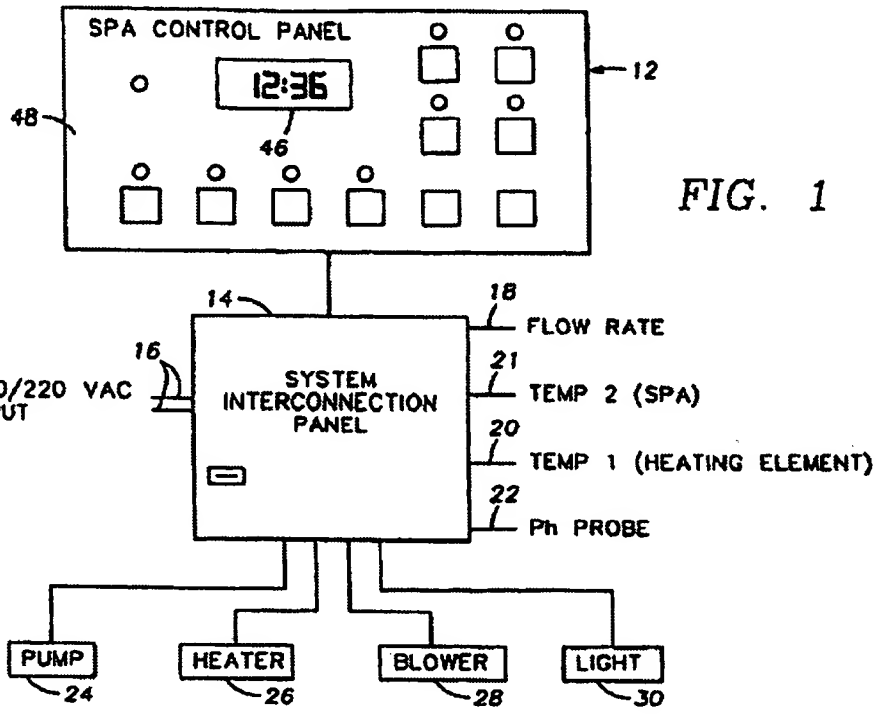

SPA CONTROL PANEL
12:36
12
48
46
14
16
110/220 VAC INPUT
SYSTEM INTERCONNECTION PANEL
18
FLOW RATE
21
TEMP 2 (SPA)
20
TEMP 1 (HEATING ELEMENT)
22
Ph PROBE
PUMP
24
HEATER
26
BLOWER
28
LIGHT
30

FIG. 1

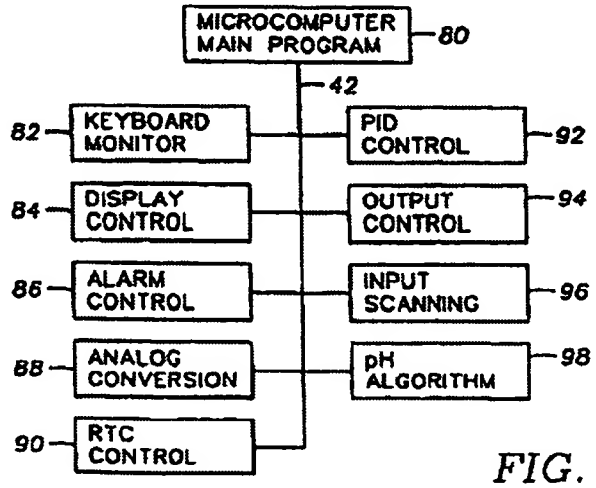
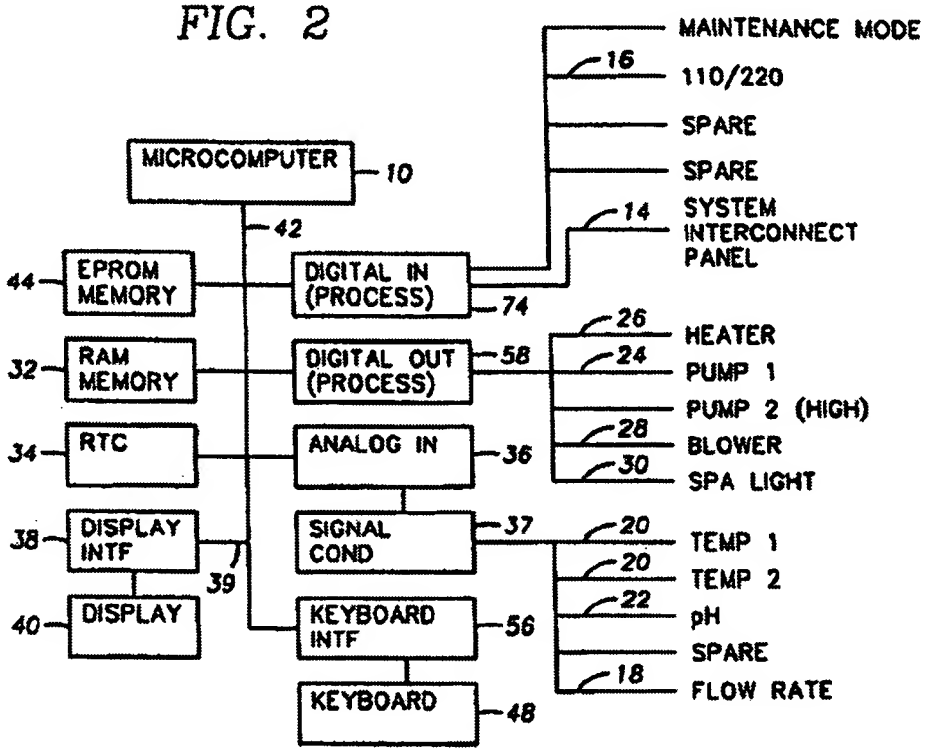

MICROCOMPUTER MAIN PROGRAM
80
42
82
KEYBOARD MONITOR
84
DISPLAY CONTROL
86
ALARM CONTROL
88
ANALOG CONVERSION
90
RTC CONTROL
PID CONTROL
92
OUTPUT CONTROL
94
INPUT SCANNING
96
pH ALGORITHM
98

FIG. 4

FIG. 2


MICROCOMPUTER
10
42
44
EPROM MEMORY
32
RAM MEMORY
34
RTC
38
DISPLAY INTF
39
40
DISPLAY
DIGITAL IN (PROCESS)
74
DIGITAL OUT (PROCESS)
58
ANALOG IN
36
SIGNAL COND
37
KEYBOARD INTF
56
KEYBOARD
48
MAINTENANCE MODE
16
110/220
SPARE
SPARE
14
SYSTEM INTERCONNECT PANEL
26
HEATER
24
PUMP 1
PUMP 2 (HIGH)
28
BLOWER
30
SPA LIGHT
20
TEMP 1
20
TEMP 2
22
pH
SPARE
18
FLOW RATE

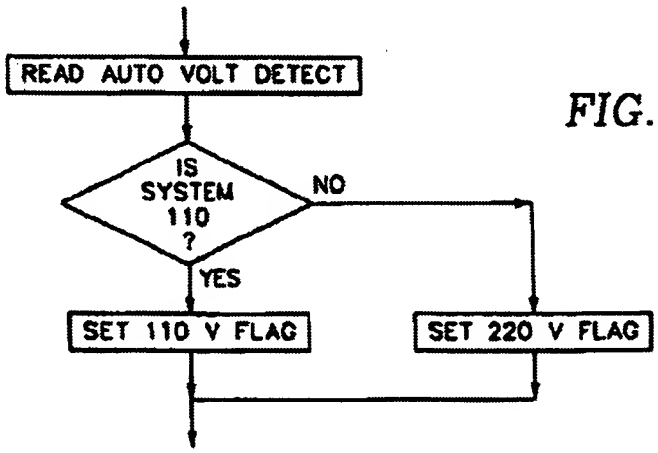

READ AUTO VOLT DETECT
IS SYSTEM 110 ?
NO
YES
SET 110 V FLAG
SET 220 V FLAG

FIG. 8

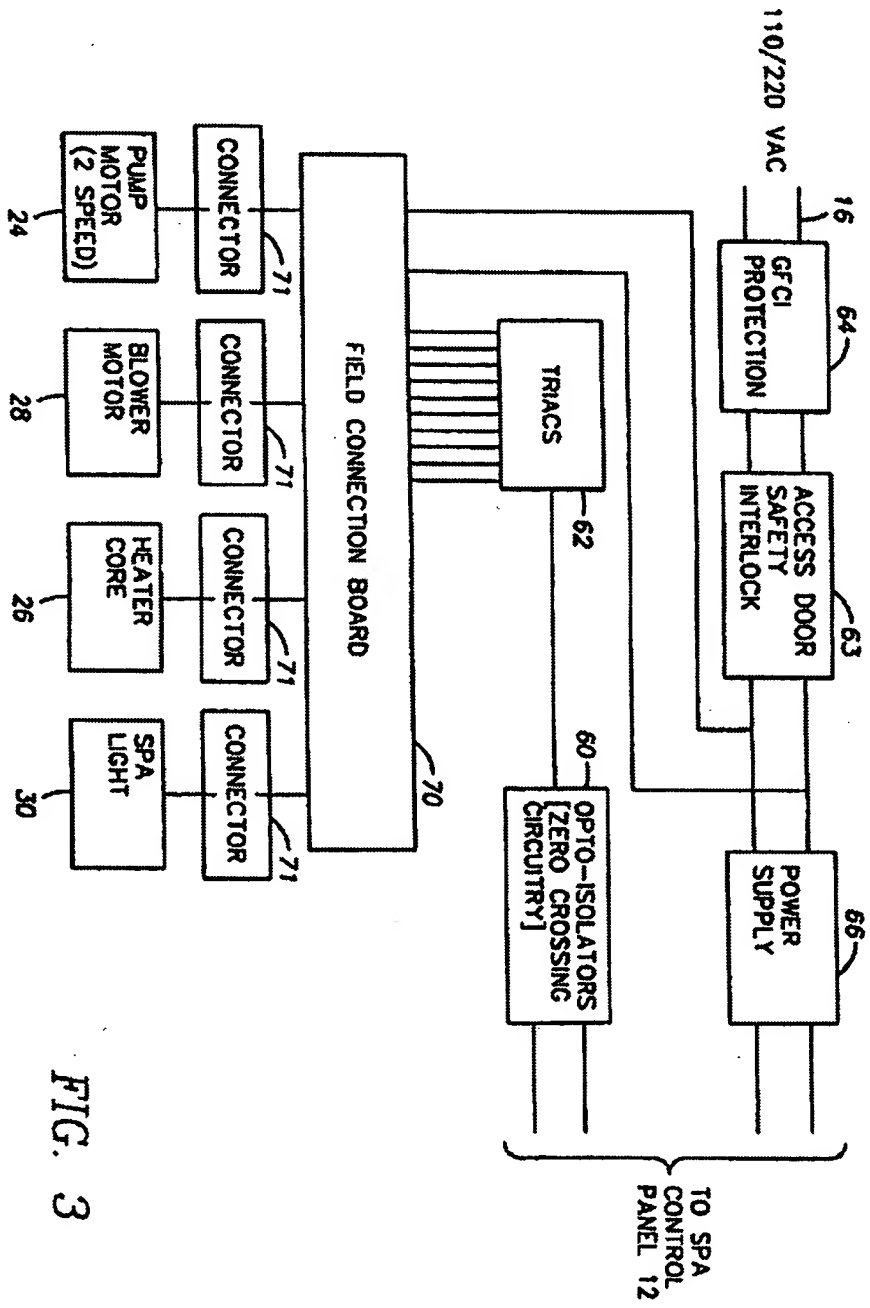

110/220 VAC
16
GFCI PROTECTION
64
ACCESS DOOR SAFETY INTERLOCK
63
POWER SUPPLY
66
TRIACS
62
OPTO-ISOLATORS [ZERO CROSSING CIRCUITRY]
60
TO SPA CONTROL PANEL 12
FIELD CONNECTION BOARD
70
CONNECTOR
71
PUMP MOTOR (2 SPEED)
24
BLOWER MOTOR
28
HEATER CORE
26
SPA LIGHT
30

FIG. 3

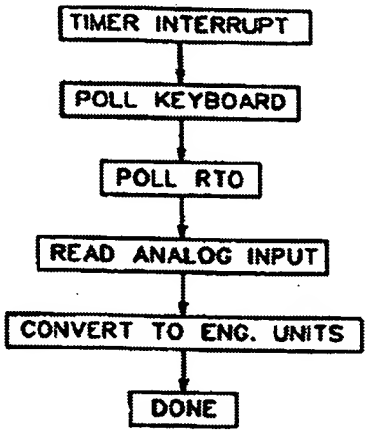


FIG. 12

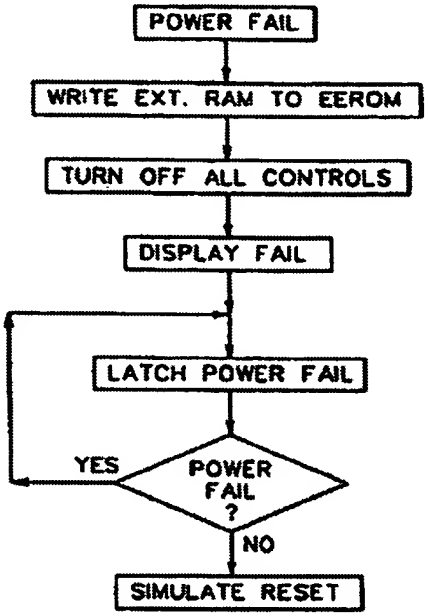


FIG. 13

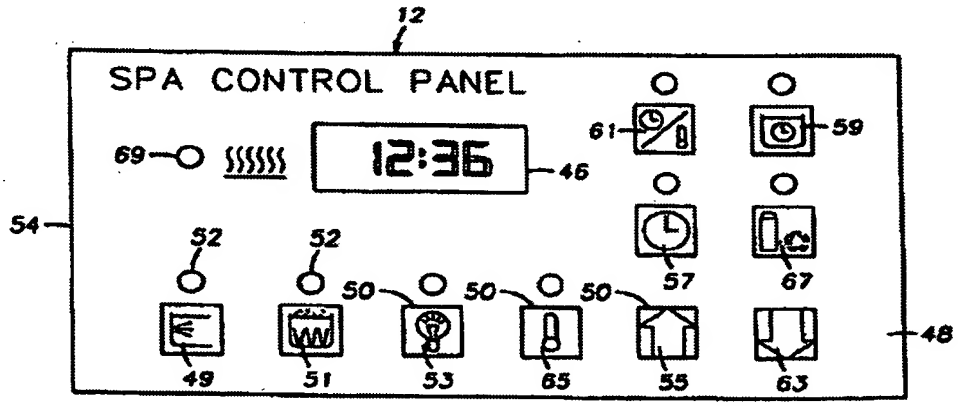


FIG. 5

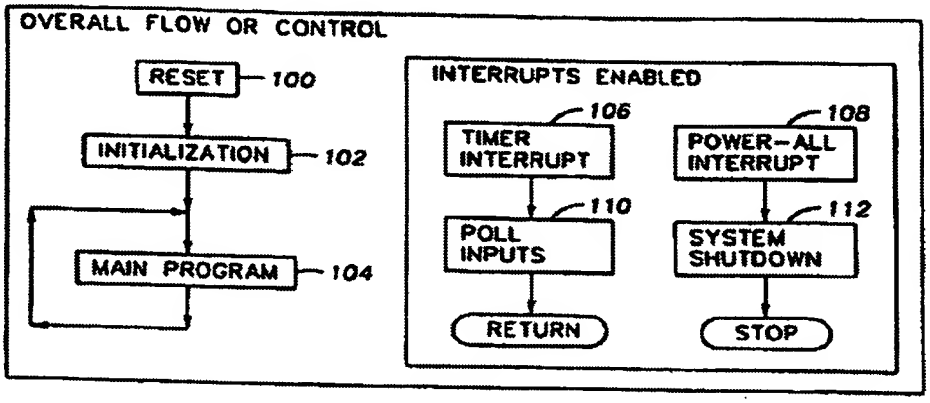

OVERALL FLOW OR CONTROL
RESET
100
INITIALIZATION
102
MAIN PROGRAM
104
INTERRUPTS ENABLED
106
TIMER INTERRUPT
108
POWER-ALL INTERRUPT
110
POLL INPUTS
112
SYSTEM SHUTDOWN
RETURN
STOP

FIG. 6

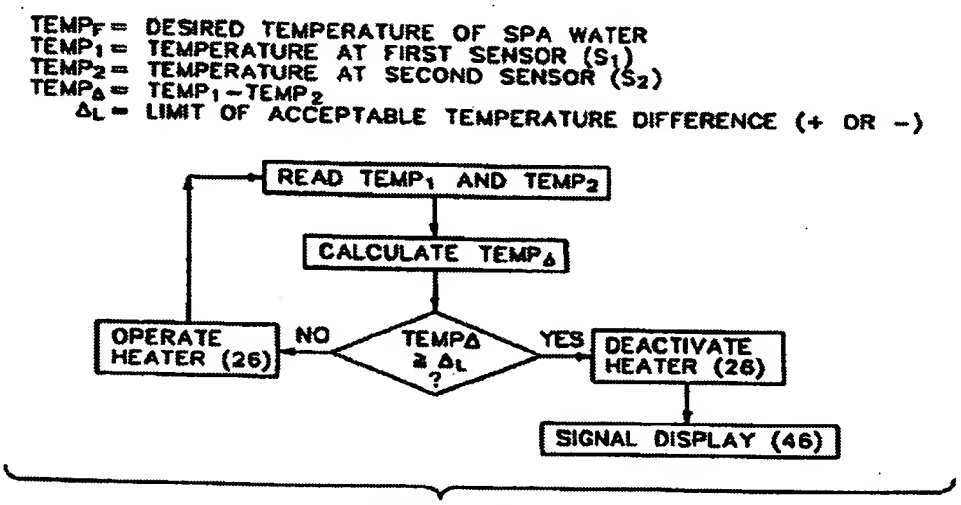

TEMPF = DESIRED TEMPERATURE OF SPA WATER
TEMP1 = TEMPERATURE AT FIRST SENSOR (S1)
TEMP2 = TEMPERATURE AT SECOND SENSOR (S2)
TEMPΔ = TEMP1 - TEMP2
ΔL = LIMIT OF ACCEPTABLE TEMPERATURE DIFFERENCE (+ OR -)
READ TEMP1 AND TEMP2
CALCULATE TEMPΔ
OPERATE HEATER (26)
NO
TEMPΔ ≥ ΔL ?
YES
DEACTIVATE HEATER (26)
SIGNAL DISPLAY (46)

FIG. 7

$RATE$ = RATE OF HEATING
$RATE_{AV}$ = RATE OF HEATING (AVERAGE)
$TEMP_I$ = INITIAL TEMPERATURE OF SPA WATER
$TEMP_F$ = DESIRED TEMPERATURE OF SPA WATER
$TEMP_\Delta$ = $TEMP_F - TEMP_I$
$TIME_I$ = TIME (INITIAL)
$TIME_F$ = TIME (FINAL)
$TIME_\Delta$ = $TIME_F - TIME_I$

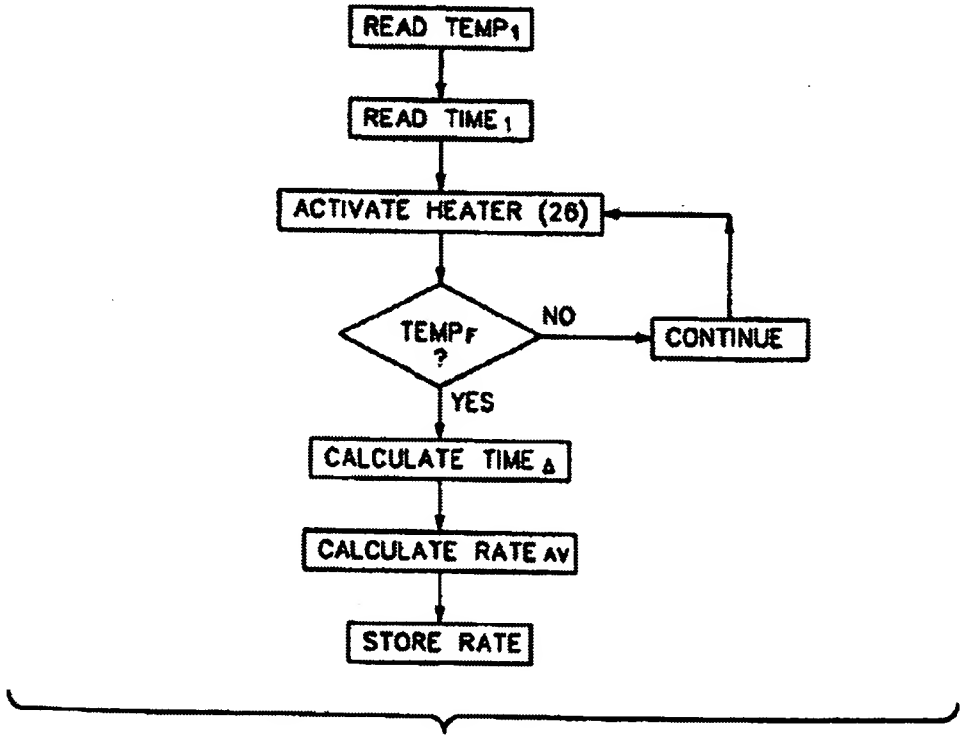


FIG. 9

$TEMP_I$ = INITIAL TEMPERATURE OF SPA WATER
$TEMP_F$ = FINAL (DESIRED) TEMPERATURE OF SPA WATER
$TEMP_\Delta$ = $TEMP_F - TEMP_I$
RATE = RATE OF HEATING
$RATE_{AV}$ = RATE OF HEATING (AVERAGE)
$TIME_I$ = TIME (INITIAL)
$TIME_F$ = TIME (FINAL)
$TIME_\Delta$ = $TIME_F - TIME_I$

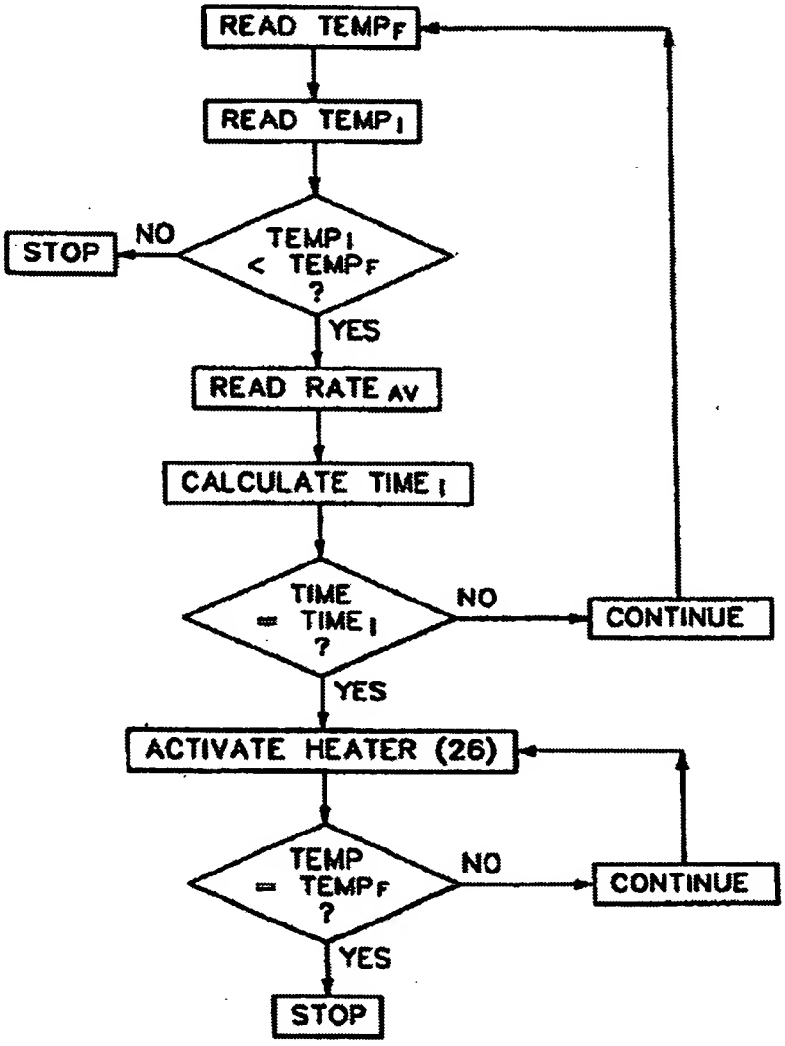


FIG. 10

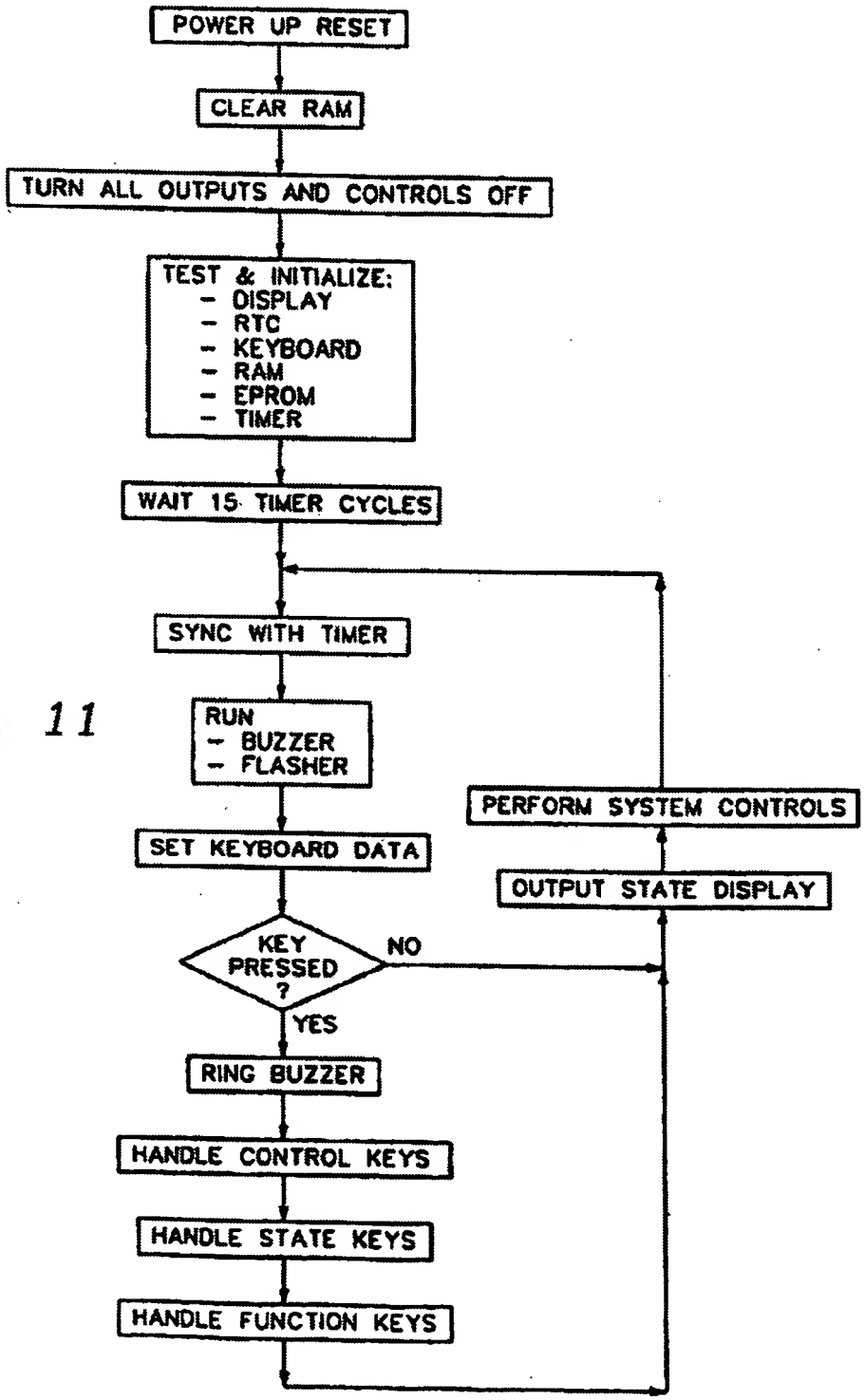

POWER UP RESET
CLEAR RAM
TURN ALL OUTPUTS AND CONTROLS OFF
TEST & INITIALIZE:
- DISPLAY
- RTC
- KEYBOARD
- RAM
- EPROM
- TIMER
WAIT 15 TIMER CYCLES
SYNC WITH TIMER
RUN
- BUZZER
- FLASHER
SET KEYBOARD DATA
KEY PRESSED ?
NO
YES
RING BUZZER
HANDLE CONTROL KEYS
HANDLE STATE KEYS
HANDLE FUNCTION KEYS
PERFORM SYSTEM CONTROLS
OUTPUT STATE DISPLAY

FIG. 11